UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Forest Insect and Disease Management
P.O. Box 5895, Asheville, N.C. 28803

Report No. 79-1-15

3400
April 27, 1979

Ralph C. Winkworth, Director
North Carolina Division of Forest Resources
P.O. Box 27687
Raleigh, N.C. 27611

Dear Mr. Winkworth:

During March Don Rogers brought some white pine samples from the Edwards Nursery into our lab to see if we could determine if foliage blight and root rot were related. The sample size and the variability within the samples makes it difficult to make a conclusion but it does seem a relationship exists.

Bob Anderson, Supervisory Pathologist and Elinor Earle, Biological Laboratory Technician evaluated the seedlings. Their findings are reported below:

Periodically, for several years a foliage blight of white pine has caused a premature discoloration and loss of foliage at the Edwards State Nursery in North Carolina. In the past, the disease has been controlled by foliage sprays. In 1979, the seedlings were not sprayed throughout the growing season and several of the seedlings became severely discolored and lost most of their foliage, while others were also discolored and lost part of their foliage, and the remainder were disease free. The pattern of damage indicated that a relationship between the foliage blight and root rot may exist. This evaluation was made to determine if this relationship existed.

METHODS

Fourteen seedlings of each category provided by the state nursery (major foliage discoloration and loss, partial foliage discoloration and loss, and healthy) were examined for root rot by completely stripping each root and recording the portion of the total root lenght that had root rot.

RESULTS

The healthy seedlings did not have any distinguishable root rot, while 69% of the affected seedlings had some root rot. The seedlings with root rot ranged from 1 to 99% of the root length rotted. On the average about 7% of the total root length of the diseased trees had root rot (Table 1).

DISCUSSION

Overall, this evaluation suggests a relationship between root rot and foliage blight. A number of the rotted roots were broken off during lifting. If these roots had remained intact, the amount of root rot may have been higher. The reason for 31% of the foliage disease seedlings with no root rot is unknown, but we suspect that the rotted roots may have been broken off in lifting. Obviously, one of the primary questions is cause-effect. Did the rot or the foliage blight occur first? This we do not know, but suspect the root rot came first and probably predisposed the seedlings to the foliage blight. This sample was very small and was not replicated over time which gives a fairly high chance for a sampling error. If the foliage blight reoccurs in the future, a more intensive evaluation of this type should be conducted. We did notice that the healthy trees were smaller. Whatever factor that may have controlled the size may also be influencing the foliage blight.

If the problem does reoccur, feel free to contact us and we will plan to conduct a more intensive evaluation.

Also, we suggest that all 2-0 white pine seedbeds at the Edwards Nursery be treated each year according to the foliage spray recommendations furnished by Ed Cordell in past years. This treatment has been very effective in preventing similar white pine foliage disease problems in Tennessee, South Carolina, and Kentucky -- as well as North Carolina prior to 1979. Therefore, this treatment is apparently the most effective and efficient means of preventing the foliage discoloration and loss aspect of this apparent root rot -- foliage disease complex.

Finally, we would also suggest that you review the methyl bromide soil fumigation precautionary factors enclosed with this report in an effort to improve the effectiveness of your methyl bromide soil fumigation -- particularly against root rot disease problems.

Sincerely,

Harold W. Flake

HAROLD W. FLAKE
Field Representative

cc: Don Rogers, Edwards Nursery
Ed Cordell
Harvey Toko
Coleman Doggett

Table 1.--Percent of white pine root systems with root rot by foliage loss categories.

Category	Average Length of Root (cm)	Average Length With Root Rot (cm)	% Root Rot (cm)
Major foliage discoloration and loss (75% or)	118	8	7
Partial foliage discoloration and loss (74% or)	143	7	6
Healthy	93	0	0

Suggested guidelines and precautions for effective soil fumigation.

Soil fumigation factors	Guidelines and precautions
Soil preparation	Work into fine, loose, friable condition to minimum depth of 8-10 in (20-25 cm) Soil as free of clods as possible
Organic matter	Avoid excess non-decayed organic matter which absorbs fumigant and serves as reservoir for fungi and nematodes Green organic matter cut or chopped into soil minimum of 3-4 weeks prior to fumigation
Soil moisture	Soil moisture neither too high nor too low Light sandy soils - slightly below field capacity Heavy clay soils - 50-75% field capacity
Soil temperature	Soil temperature above 50°F (10 C) at 6-in (15 cm) depth Air and soil temperatures not correlated
Soil fumigants and target pests	MC-2® type fumigant - broad spectrum for nematodes, weeds, and most soil-borne fungi MC-33® type fumigant - particularly effective against soil-borne fungi with tough resistant spore stages Brozone® type fumigant - less effective against soil-borne fungi
Calibrating and monitoring soil fumigation equipment	Fumigant dosage = concentration X time Dosage determined by injector nozzle size, fumigant pressure and tractor speed Fumigant injected at minimum 8-in (20 cm) soil depth Constant pressure, tractor speed, and fumigant flow maintained through all nozzles for uniform effective coverage
Soil tarping	Minimum 2-mil thickness clear polyethylene tarp applied immediately following fumigation Alternate strips - require longer time intervals and affords opportunity for contamination from adjacent non-fumigated soil strips Solid tarping - requires shorter time interval and minimizes opportunity for soil contamination Any holes and open glue joints repaired and sealed immediately
Fumigation exposure period	Fumigant label consulted for recommendation Minimum of 48 hours at soil temperatures above 60°F (15 C) at 6-in (15 cm) depth At lower temperatures and during wet weather (following fumigation) the exposure period should be doubled

Soil fumigation factors	Guidelines and precautions
Fumigation aeration period	Fumigant label consulted for recommendation Minimum of 48-72 hours - varies with fumigant, soil, temperature, moisture, and crop to be planted Aeration period doubled during wet weather and/or at temperatures below 60°F (15 C)
Extended aeration periods for mycorrhizae seed-bed artificial inoculations	Minimum soil aeration period of 3 weeks required following MC-33® type fumigation This stronger fumigant has extended residual toxicity to all soil fungi-including the mycorrhizae fungal symbionts
Fumigated soil contamination	Avoid possible contamination by movement of soil, plants, mulches, etc., into fumigated areas Clean, by steam or equivalent, all equipment - plows, bed shapers, tractor tires, etc. Avoid transplanting from non-fumigated soils
Fumigation of mulch materials	Mulch materials such as pine needles, straw, and sawdust prefumigated with MC-33® or MC-2® type formulations at dosage rate of 1.0 lb/yd^3 (0.6 kg/m^3) Tightly compacted or baled materials should be maximum of 18 in (45 cm) deep Loose pine needles, straw, etc. may be 3-4 ft (2.75-3.50 m) deep Fumigation procedures and precautions (tarping, temperature moisture, exposure, aeration periods, etc.) are same as for soil fumigation
Soil nutrient alterations	Level of soluble salts and ammonia nitrogen may be increased due to decreased populations of nitrifying bacteria Ammonia fertilizers should not be used on plants requiring nitrates or those sensitive to ammonia Apply only nitrate fertilizers until crop is established and soil temperature is above 65°F (18 C) Fertilization recommendations based on soil tests made after fumigation
Water requirements	Water requirements per unit of plant production are generally less Water requirements per acre increased due to generally larger plants and increased production
Cover crops	Green manure cover crop plants such as corn, peas, and soybeans are highly susceptible hosts for M. phaseolina Grain crops such as millet or rye are considered as nonhosts

Soil fumigation factors	Guidelines and precautions
Safety	The methyl bromide - chloropicrin formulations are highly toxic to animals (including humans) and plants Fumigants must be handled with care and only by certified competent personnel ALWAYS READ FUMIGANT LABEL PRIOR TO USE AND FOLLOW ALL DIRECTIONS AND PRECAUTIONS CLOSELY